directed to some other matter. The whole question of lunar influence on meteorological phenomena might be settled in a comparatively short space of time if the civilised countries of the world could agree to record all observations during a few years according to lunar instead of solar coordinates. Other problems will readily suggest themselves to you, and several might possibly be dealt with simultaneously.

The great reform I have in view is this :—Before you observe, make sure that your observations will be useful and will help to answer a definite question.

I hope that, though my frankly outspoken criticisms may not command universal assent, you will agree that there is some foundation for them, and, if so, the time is obviously not well chosen when observational science can be separated from its mathematical and experimental sisters. We hope that cosmical physics may remain an integral portion of Section A, and, though we acknowledge our weaknesses, we claim to have also something to teach.

I hope that our proceedings this week may show that we can put aside observational detail and throw some light on the great and important problems with which our science is concerned.

MATHEMATICS AND PHYSICS AT THE BRITISH ASSOCIATION.

ALTHOUGH the number of communications made to the Section at Belfast was less than at Glasgow last year, there was no decrease in the interest of the meetings. The inclusion of cosmical physics in the subjects dealt with by the department for astronomy materially increased the attendance at the meetings of that department.

In the mathematical department, Miss Hardcastle described the ground covered by the second part of her report on the present state of the theory of point groups, and stated that a further communication would be necessary to bring the report up to the present time. In the absence of the author, Prof. Forsyth gave a short account of Mr. E. T. Whittaker's solutions of the partial differential equations of mathematical physics. Mr. Whittaker finds that an expression of the type

$$\int_0^{2\pi} f(z + ix\cos u + iy\sin u, u)\, du$$

is the most general solution of the potential equation of Laplace, where f is an arbitrary function of the arguments

$$z + ix\cos u + iy\sin u \text{ and } u, \text{ and } i = \sqrt{-1}.$$

It follows that Legendre's, Bessel's and other well-known solutions of the equation are special forms of Mr. Whittaker's. In the same way, the general solution of the equation of wave motion is of the type

$$\int_0^{2\pi}\int_0^{\pi} f(x\sin u\cos v + y\sin u\sin v + z\cos u + \frac{t}{k}, u, v)\, du\, dv,$$

where f is an arbitrary function. Mr. Whittaker points out that this solution may be analysed into plane waves, and therefore supports the conclusion arrived at by Dr. Johnstone Stoney in 1897, that all disturbances in the ether can be resolved into trains of plane waves.

In the department of physics, Lord Rayleigh brought forward the question of the accurate conservation of weight in chemical reactions. He considered the discrepancies found by experimenters too large to allow the law of conservation to be accepted as proved, and hoped that the experiments at present being carried out by Landolt and Heydweiller would soon lead to a definite conclusion. Prof. Morton described the experiments he and Mr. Hawthorne had carried out on the motion of a detached thread of liquid in a capillary tube. He concludes from them that there is some force of the nature of an attraction between the liquid and the material of the tube, which must be taken into account to explain completely the phenomena observed. He further detailed how he had, in conjunction with Mr. Vinycomb, repeated and extended the work of Raps on the mode of vibration of stretched strings, and investigated the effect of the rigidity of the support on the motion of the string.

Dr. Barnes, of Montreal, on continuing his experiments on the critical velocity of flow of water through tubes, has found that the velocity varies with temperature in the way anticipated from the viscosity term in the expression given by Prof. Osborne Reynolds in his classical paper on critical velocity. By applying in the case of mercury the method used in determining the specific heat of water, he has also found that the specific heat of mercury decreases at a rate which itself decreases slightly with increase of temperature. Lord Kelvin sent a short communication in which he suggested that the temperature of an animal surrounded by a saturated atmosphere hotter than itself was kept down by evaporation within the lungs.

Dr. J. Larmor, in a paper on the application of the method of entropy to radiant energy, showed that by defining the entropy of a given space containing radiant energy distributed in any arbitrary way, as the logarithm of the probability of the existence of that particular distribution, the law of distribution of the energy with wave-length, which was recently deduced by Planck by considering a space filled with electrical resonators, could equally well be established. According to it, the amount of energy between wave-lengths λ and $\lambda + d\lambda$ radiated by a perfectly black body at absolute temperature t is proportional to

$$\frac{1}{\lambda^5}\,\frac{1}{e^{\frac{a}{\lambda t}} - 1}$$

where a is a constant.

Mr. Petavel gave an account of the work he had done towards the production of a standard of light. He considered that the incandescent surface of a metal of the platinum group heated electrically furnished the best source, and proposed to fix the temperature of that source by the equality of the radiation transmitted by suitable thicknesses of two media, the absorption of one of which (water) increased, and of the other (black fluorspar) decreased, with increase of temperature of the source. Dr. C. S. Myers called attention to a variation of pitch of Galton and other high-frequency whistles when the wind pressure was changed, which he had not been able to explain.

Lord Rayleigh prefaced a description of his own experiments to determine whether double refraction was produced in isotropic transparent bodies by their motion through the ether, by an account of those of Michelson and Morley. The latter led to the conclusion that light travelled with the same velocity, whether the direction of transmission was coincident with, across or opposed to that of the motion of the body. Lord Rayleigh's arrangement would have enabled a change of velocity of 10^{-10} of the velocity of light to be detected, but no change was observed when the light was transmitted through water or carbon bisulphide. The experiments on solids are not yet concluded.

Dr. Johnstone Stoney forwarded a note in which he showed that by substituting for Huyghen's wave surface a wave film of finite thickness, within which the phases of the disturbances were given proper values, the disturbance propagated to a point outside the wave surface could be accurately calculated. In a second note, Dr. Stoney showed how his method of resolving the light traversing any isotropic medium into trains of plane waves might be applied to explain several optical phenomena which have not hitherto yielded to other methods.

Prof. E. Wilson described his experiments on the use of a magnetic detector in space telegraphy. His detector consists of an iron ring magnetised to instability by a current through a coil wound on the ring. The electric waves falling on the ring slightly disturb its magnetic state, and the disturbance is indicated by the sound produced in a telephone in series with a second coil wound on the ring. He finds such a detector very convenient and satisfactory in working.

Prof. Minchin has found that a coherer consisting of a carbon rod lightly supported in aluminium stirrups in an evacuated glass tube decoheres better than any other form he has tried, and is now engaged in applying the arrangement to long-distance transmission.

Dr. Marchant showed that the graphical method of determining the discharge of a condenser through a variable inductance gave results which agreed very closely with the calculated discharge in those cases in which the calculation could be carried out.

Mr. Butler-Burke gave a short account of his work on the phosphorescence produced in partially exhausted tubes by the passage of an alternating current round them. He concludes that it is due to the formation of groups consisting of a large number of molecules of gas within the tube.

In the department of astronomy and cosmical physics, Dr. W. E. Wilson exhibited a bolometer arranged to record solar radiation. It consists of two blackened coiled platinum wires, on one of which the light of the sun is allowed to fall through an opening in the metal box in which both are enclosed. The Rev. A. L. Cortie has examined in detail the Greenwich records of sun-spots and faculæ, and the diurnal ranges of the declination magnet, for the years 1899-1901, and finds that there is not sufficient accordance to support the statement sometimes made that sun-spots cause magnetic storms. He considers the two are correlated effects of some common cause still to be found.

The committee for investigating the upper atmosphere by means of kites gave a report of flights made from their station near Oban during July and August. The average height reached was about 3500 feet, and the average rate of decrease of temperature upwards about 3°·5 F. per 1000 feet.

Dr. Shaw, in his communication on radiation in meteorology, pointed out that radiation or absorption of heat by a cloud would result in motion of the cloud downwards or upwards. This motion would produce in its turn a heating or cooling of the cloud opposed to the initial change, and a much more careful and extended study of the radiation from clouds than had hitherto been attempted was necessary before several of the problems connected with cloud motion could be solved. He suggested several ways in which observers with simple instruments could help toward the solution of these problems.

Prof. Milne, in presenting the report of the Seismological Committee, stated that each of the recent West Indian eruptions had been preceded by sudden readjustments of the strata in the neighbourhood, which left their traces on the earthquake-recording instruments. This may, after further investigation, lead to a method of predicting eruptions.

Dr. Roberts exhibited photographs of nebulæ illustrating the nebular theory of the evolution of star systems, from cloudy nebulæ, through the spiral stage, to star clusters.

Mr. Hinks opened a discussion on the nebula surrounding Nova Persei by showing that some of the phenomena exhibited by the nebula might be due to its being ring-shaped. Photographs exhibited by Dr. Roberts did not, however, appear to support this view, and there seems little hope of coming to any definite conclusion as to the nature of the nebula until more information as to its appearance is available. C. H. LEES.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE total number of communications brought before Section C at Belfast was thirty-five. None of them can be said to have been of really great importance, but they were for the most part records of good work. The Committee on Life-zones in the Carboniferous Rocks sent in an admirable report of careful and systematic fossil-collecting. The Committees on the Underground Waters of N.W. Yorkshire and on Erratic Blocks were also able to show excellent work, and Prof. W. W. Watts, as usual, brought a good series of photographs which had been collected by his committee during the past year. Proceedings opened on Thursday, September 11, with the president's address, which has already been printed in our columns. It was followed by a lecture on the geology of the country around Belfast by Prof. Grenville A. J. Cole. On the morning of Sept. 15 Prof. Cole gave a second lecture, on the geological structure of Ireland; both lectures were illustrated by lantern slides and were listened to with close attention by large audiences. A considerable number of the papers naturally dealt with the geology of Ireland, and it may be convenient to notice them first and then to mention some of the other communications in geographical order. A proof-sheet of the Drift edition of the geological map of Ireland was exhibited by Mr. Teall, the director of the Survey. He explained that it was printed in colour instead of being hand-coloured, and was consequently clearer and would cost much less than the hand-coloured maps now issued by the Survey.

The post-Glacial deposits of the Belfast district were described in a most interesting paper by Mr. R. Lloyd Praeger. A peat bed, representing an old land surface, is found 20 feet below low water at Belfast, but between tides at other places in the district. In it remains of the Irish elk have been found, and a little above it there is some 12 feet of blue clay, the upper part of which contains *Thracia convexa* and other shells, indicating a warmer climate than the fauna now living in the Irish Sea and a depth of five to ten fathoms, whilst in the lower part of the clay, *Scrobicularia piperata* and fossils of a shore type are found.

Mr. P. F. Kendall read a paper by Madame Christen giving an account of the recent work of the Belfast Field Club. The members have made a careful study of the drifts of the district. They have, for example, proved the transport of the Rhyolite of Tardree to the north as well as in other directions. Attention was also drawn to the wide dispersal through the district of blocks from Ailsa Craig, and it was stated that these blocks are practically always found associated with marine shells. The committee appointed to explore Irish caves was able to show excellent work in the caves of Keishcorran Mountain, a mass of Carboniferous Limestone fifteen miles south of Sligo. In the Coffey Cave, bones of the Arctic lemming had been found in considerable numbers. This, the report states, is the first record of its existence as a former inhabitant of Ireland. Excavations in an extensive series of caves at Edenvale, county Clare, were described. Remains of bear and of the Irish elk were recorded, as well as human implements, ornaments, &c., and Mr. R. J. Ussher, who read the report, said that he hoped for important evidence of the state of prehistoric Ireland from further exploration.

Mr. Joseph Wright announced his discovery of large numbers of marine Foraminifera in Boulder-clay from various places in Ireland and also from England, Wales, Scotland, the Isle of Man and Canada. He more especially dealt with the Boulder-clay of Knock Glen, near Belfast. From it he had obtained seventy-nine species, and he suggested a considerable depression of the area at the time of its deposition. This led to an animated discussion, Prof. Boyd Dawkins supporting the author's view and Messrs. Lamplugh and Kendall contending for a transport of the clay to its present position by land ice.

A paper by Mr. R. Clark dealt with the Silurians of north-east Ireland. The author described some new fossil localities and gave lists of the species found.

Mr. G. Barrow read a paper on the prolongation of the Highland Border rocks into county Tyrone. The author referred to the Jasper and green-rock series, which he had found between Blairgowrie and Stonehaven (*Q.J.G.S.* vol. lvii. p. 328), and explained that he believed it to correspond with a series found by Mr. Peach near Omagh. He thought these rocks were intermediate in age between the Highland rocks, which he looked upon as Archæan, and a newer series, the Pomroy rocks, of Silurian age.

An interesting discussion followed the reading of this paper.

Mr. McHenry agreed that in Ireland there are three series:—(1) An old series, which he thought was probably metamorphosed Llandeilo and Bala; (2) the green rocks; and (3) the Pomroy rocks, which are mapped Lower Silurian, but contain Devonian and Wenlock fossils with a few survivors of Bala type. The conglomerates of this third series contain pebbles of the green rocks. He agreed that the line between the green rocks and the older series was a great thrust which in his opinion affected the Old Red Sandstone. He had followed it south-west to Castlebar and Clew Bay into Clare Island.

Mr. Teall agreed that this line of disturbance in Ireland should be classed with that which the author had worked out in Forfarshire, but he thought further evidence was required as to the age of the rocks. Dr. Matley, Prof. Cole, Prof. J. F. Blake and Mr. Cunningham-Craig also spoke. In reply, the author said he was sure of the order of succession, but not of the precise age of the rocks.

A list of 113 minerals known to occur in Ireland was contributed by Mr. H. J. Seymour. He explained that it was but of a preliminary character and that he had only included species which he was satisfied really have been found in the country.

Passing to Scottish geology, a paper of very great interest was sent in by Mr. Kynaston and was read by Mr. Teall. The author described a series of volcanic rocks in the district extending from Glen Coe to the Black Mount. The lower part consists of some 1500 feet of basic andesites with sandstone, shale and conglomerate at the base. Above these andesites are agglomerates and breccias capped by some 700 feet of hornblende andesite. Messrs. Peach and Tait have discovered plant remains in a bed of black shale associated with these lavas which enable the author to fix their age as Lower Old Red Sandstone; that is, they are of the same date as the great volcanic series of Lorn.

The author then showed that the granite of Ben Cruachan